

Comments on "HFCs and HFC Alternatives in split air conditioning systems":

General feedback on this input: The authors are well known consultants with profound background for F-Gas inventories in France and Germany. We would like to express doubts on the assumed end-of-life leakages that might be not taken into account with the most recent reported analysis for other countries than France/Germany. For non-EU see for example AHRI (*Review of Refrigerant Management Programs*, AHRI Project 8018 Final Report, 2016) or the Japanese Ministry of Environment about the HFC emissions (*Directions for Measures to Improve Recovery Rate of Fluorocarbons at the Time of Disposal*, <https://www.env.go.jp/press/files/jp/110783.pdf>, 2019) and for EU please see the report from the Nordic Council of Ministers (*F-Gas methodologies and measurements and in Nordic Countries*, Nordic Council of Ministers, 2019) to reflect a more comprehensive state-of-the-art in end-of-life leakages. Especial the statements in the latter report (see page 36) could reflect eol leakage rates that are even smaller as it might be taken into account by the EU commission and the consultants (including their historical background on eol leakage rates):

In addition, a recent Norwegian study indicates that the recovery rate in reality is rather low. The study indicates that there are large differences between amounts put into the market and amounts received for controlled destruction at end of life 5. Even though stakeholders receive a high refund per kg F-gas (600 – 1,700 DKK per kg), only 16% of the gasses are received for destruction. The study also indicates that approx. 50% of all heat pumps delivered for disposal as WEEE waste, were emptied of F-gases. In theory, these charges could all have been emitted.

Especially this statement is interesting. It reflects either an early behaviour of refrigerant recycling (even before the refrigerant prices reached its maxima in 2018) or the common practice that you would not assume to have in a highly developed Nordic country and that even has economical incentives for the recovery of refrigerants. The report from the consultants does not include a discussion and possible conclusions that should take into account such recovery rates. Especially when it comes to Ecodesign review reports often there are wrong recovery rates announced. When evaluating the French and German reports written by the consultants the state of the art in recovery rates could even be worse when comparing it to the above mentioned reports from AHRI, Nordic Council and the Japanese ENV.

Feedback on section 3 "relevance of alternatives" and here the statement on training:

The authors could have discussed more about the pros and cons why or why not (a legal framework) for training on flammable refrigerant would be necessary. Actually the ATEX workplace directive would defined such a legal framework. Certainly, an explicit training framework could be realized but it is not completely necessary.

Feedback on section 4 "technical feasibility": The authors state that single and small multi-split systems could reach 0,25 kg/kW cooling capacity. Refrigerant charges in refrigerant cycles have substance-specific charges. This charge becomes very small when refrigerants like propane are going to be used. The specific charge limit that could technically be reached could be much lower than announced in the consultant's statement.

Feedback on section 6 "alternatives in the pipeline": The authors' bibliography/footnote collection on bibliographic resources is not complete. The authors cite a NEDO project with a fuzzy statement on "lower GWP alternatives" aiming at GWP below 10 and being available in the time slot between 2018-2023. What is the literature resource used for this statement?